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TITLE: Adaptive matched filter and vector correlator for a code division multiple access (CDMA) modem

Detailed Description Text (30):
As shown in FIG. 2c, up to 63 spreading-code sequences C.sub.o through C.sub.63 are generated by tapping the output signals of FFs 203 and logically adding the short sequence C* in a binary adders 213, 214, and 220, for example. One skilled in the art would realize that the implementation of the FF 203 create a cumulative delay effect for the code sequences produced at each FF stage in the chain. This delay is due to the nonzero electrical delay in the electronic components of the implementation. The timing problems associated with the delay can be mitigated by inserting additional delay elements into the FF chain. An exemplary FF chain with additional delay elements is shown in FIG. 2d.

Detailed Description Text (141):
FIG. 15 indicates that the Code Generator 1304 provides the code sequences Pn.sub.i (t), I=1, 2, . . . I used by the receive channel despreaders 1703, 1704, 1705, 1706, 1707, 1708, 1709. The code sequences generated are timed in response to the SYNK signal of the system clock signal and are determined by the CCNTRL signal from the modem controller 1303 shown in FIG. 11. Referring to FIG. 15, the CDMA modem receiver section 1302 includes Adaptive Matched Filter (AMF) 1710, Channel despreaders 1703, 1704, 1705, 1706, 1707, 1708, 1709, Pilot AVC 1711, Auxiliary AVC 1712, Viterbi decoders 1713, 1714, 1715, 1716, Modem output interface (MOI) 1717, Rotate and Combine logic 1718, 1719, 1720, 1721, AMF Weight Generator 1722, and Quantile Estimation logic 1723.

Detailed Description Text (146):
The Auxiliary AVC 1712 also receives the I and Q digital receive message signal data and, in the described embodiment, includes four separate despreaders 2001, 2002, 2003, 2004 as shown in FIG. 18. Each despreader receives and correlates the I and Q digital receive message data with delayed versions of the same despreading-code sequence PARI and PARQ which are provided by code generator 1304 input to and contained in shift register 2020. The output signals of the despreaders 2001, 2002, 2003, 2004 are combined in combiner 2030 which provides noise correlation signal ARDSPRDAT. The auxiliary AVC despreading code sequence does not correspond to any transmit spreading-code sequence of the system. Signals OE1, OE2, . . . OE4 are used by the modem control 1303 to enable the despreading operation. The Auxiliary AVC 1712 provides a noise correlation signal ARDSPRDAT from which quantile estimates are calculated by the Quantile estimator 1733, and provides a noise level measurement to the ACQ & Track logic 1701 (shown in FIG. 15) and modem controller 1303 (shown in FIG. 11).

Detailed Description Text (151):
The acquisition and tracking algorithms are used by the receiver to determine the approximate code phase of a received signal, synchronize the local modem receiver despreaders to the incoming pilot signal, and track the phase of the locally

generated pilot code sequence with the received pilot code sequence. Referring to FIGS. 11 and 15, the algorithms are performed by the Modem controller 1303, which provides clock adjust signals to code generator 1304. These adjust signals cause the code generator for the despreaders to adjust locally generated code sequences in response to measured output values of the Pilot Rake 1711 and Quantile values from quantile estimators 1723B. Quantile values are noise statistics measured from the In-phase and Quadrature channels from the output values of the AUX Vector Correlator 1712 (shown in FIG. 15). Synchronization of the receiver to the received signal is separated into two phases; an initial acquisition phase and a tracking phase. The initial acquisition phase is accomplished by clocking the locally generated pilot spreading-code sequence at a higher or lower rate than the received signal's spreading code rate, sliding the locally generated pilot spreading code sequence and performing sequential probability ratio test (SPRT) on the output of the Pilot Vector correlator 1711. The tracking phase maintains the locally generated spreading-code pilot sequence in synchronization with the incoming pilot signal.

Detailed Description Text (156):
The Pre-Track algorithm immediately follows the acquisition or re-acquisition algorithms and immediately precedes the tracking algorithm. Pre-track is a fixed duration period during which the receive data provided by the modem is not considered valid. The Pre-Track period allows other modem algorithms, such as those used by the ISW PLL 1724, ACQ & Tracking, AMF Weight GEN 1722, to prepare and adapt to the current channel. The Pre-track algorithm is two parts. The first part is the delay while the code tracking loop pulls in. The second part is the delay while the AMF tap weight calculations are performed by the AMF Weight Gen 1722 to produce settled weighting coefficients. Also in the second part of the Pre-Track period, the carrier tracking loop is allowed to pull in by the SE PLL 1724, and the scalar quantile estimates are performed in the Quantile estimator 1723A.

Detailed Description Text (157):
The Tracking process is entered after the Pre-Track period ends. This process is actually a repetitive cycle and is the only process phase during which receive data provided by the modem may be considered valid. The following operations are performed during this phase: AMF Tap Weight Update, Carrier Tracking, Code Tracking, Vector Quantile Update, Scalar Quantile Update, Code Lock Check. Derotation and Symbol Summing, and Power Control (forward and reverse).

Detailed Description Text (159):
Two sets of quantile statistics are maintained, one by Quantile estimator 1723B and the other by the scalar Quantile Estimator 1723A. Both are used by the modem controller 1303. The first set is the "vector" quantile information, so named because it is calculated from the vector of four complex values generated by the AUX AVC receiver 1712. The second set is the scalar quantile information, which is calculated from the signal complex value AUX signal that is output from the AUX Despreader 1707. The two sets of information represent different sets of noise statistics used to maintain a pre-determined Probability of False Alarm (P.sub.fa). The vector quantile data is used by the acquisition and reaquisition algorithms implemented by the modem controller 1303 to determine the presence of a received signal in noise, and the scalar quantile information is used by the code lock check algorithm.

Detailed Description Text (160):
For both the vector and scalar cases, quantile information consists of calculated values of lambda0 through lambda2, which are boundary values used to estimate the probability distribution function (p.d.f.) of the despread received signal and determine whether the modem is locked to the PN code. The Aux.sub.-- Power value used in the following C-subroutine is the magnitude squared of the AUX signal output of the scalar correlator array for the scalar quantiles, and the sum of the magnitudes squared for the vector case. In both cases the quantiles are then

calculated using the following C-subroutine:

Detailed Description Text (162):
where CG[n] are positive constants and GM[n] are negative constants (different values are used for scalar and vector quantiles).

Detailed Description Text (165):
where lambda[k] are as defined in the above section on quantile estimation, and SIGMA[k], ACCEPTANCE.sub.-- THRESHOLD and DISMISSAL.sub.-- THRESHOLD are predetermined constants. Note that SIGMA[k] is negative for values for low values of k, and positive for right values of k, such that the acceptance and dismissal thresholds can be constants rather than a function of how many symbols worth of data have been accumulated in the statistic.

CLAIMS:

4. The pilot vector correlator apparatus of claim 3, further comprising:

a phase locked loop (PLL) which measures a carrier phase error of the pilot data value and produces a composite carrier phase error signal; wherein each one of the plurality of despread multipath pilot signal components and the respective multipath signal weighting values is applied to a respective one of a plurality of complex multipliers with the composite phase error signal, wherein each multipath pilot signal component is multiplied by the respective weighting value and the respective phase error signal to produce a respective scaled and phase rotated pilot signal component, thereby to provide each of the plurality of scaled and phase rotated pilot signal components with a substantially equal carrier phase value.

9. The method of collecting signal power of a spread pilot channel as recited in claim 8, further comprising the steps of:

f) measuring, by a phase locked loop (PLL), a carrier phase error of the pilot data value to produce a composite carrier phase error signal; and

g) applying the composite phase error signal to respective ones of a plurality of complex multipliers with the plurality of despread multipath pilot signal components and the respective multipath signal weighting value;

wherein, in the complex multiplying step d), each multipath pilot signal component is complex multiplied by the respective weighting value and the respective phase error signal to produce a respective scaled and phase rotated pilot signal component, thereby to provide the plurality of scaled and phase rotated pilot signal components with a substantially equivalent carrier phase values.

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